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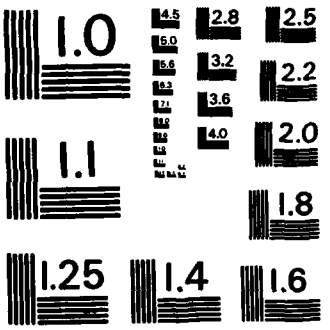

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MULTIVARIABLE PROBLEMS OF STATISTICS AND INFORMATION THEORY

FINAL REPORT

REPORT ON THE AIR FORCE GRANT AFOSR-77-3127

Research was conducted by Bose, Srivastava, and their associates on the many and various topics covered under this grant. Several achievements, some of which may turn out to be exceedingly important for the future course of the subject, have been made. Some of the designs developed combine economy and accuracy, and we strongly recommend experimenters to use them since for any particular level of precision, they lead to enormous savings in costs.

Bose worked on the theory of optimal balanced 2 or 3 level mixed factorial designs.E-optimal designs of resultion III were developed. G-balanced arrays, which are generalizations of balanced arrays, have been introduced. A Ph.D. dissertation by Iyer (1980) was written under the guidance of Professor Bose. Some papers by Bose and/or Iyer have already been published. These results are important additions to the subject of optimal discrete factorial design, founded and developed by Srivastava and her associates in the sixties, and to which the Japanese school also made notable contributions afterwards. This difficult, but very worthwhile, subject is still wide open since in the vast majority of cases the optimality of designs has been established only in certain subclasses.

Srivastava also worked in the above field and a Ph.D. dissertation under her guidance was written by A. Wijetunga (1980). Several joint papers have already been published. Here, the work was concerned with optimal balanced 3^n type of designs of resolution V, so that not only main effects (as in resolution III) but also two-factor interactions are estimable. Very major strides were made by Srivastava (with collaborators Mardekian and Anderson) on the theory of optimal symmetrical factorial designs (of general

resolution) which are not necessarily balanced, but are of the parallel flats type. This type of design is such that its points constitute a set of parallel hyperplanes in the finite Euclidean Geometry EG(n, s) of n dimensions, based on GF(s). A very major connection was established with the theory of permutation groups and with the theory of cyclotomic fields. D-optimality was studied by considering the information matrix of the experiment over such fields. This paper opens up a very broad field of research (perhaps for the next couple of decades). Further work is in progress.

Another major area opened up is by Srivastava's (fundamental) paper on designs for experiments with nested nuisance factors. This paper is extremely general in nature and opens up a large very new field of research for designing experiments so that they become very sensitive, i.e., the influence of nuisance factors be eliminated to the maximum degree. Another paper in this field with Wijetunga is submitted for publication.

A fourth major area of work of Srivastava was to look into empirical scientific work, examine experiments in which factorial designs were used, and study any general statistical features which may emerge from such examination. A beginning was made with the general field of Psychology. Many journals publishing work in Experimental Psychology were scanned (with the help of Pushpa Srivastava). Papers discussing experiments which were factorial in nature, were abstracted. A long report (Srivastava & Srivastava (1981)) was prepared on these. A paper describing a very important statistical phenomenon, which was observed in these experiments, is under preparation.

Finally, Srivastava (and her associate, Shirakura) worked on certain other aspects of optimal balanced factorial designs. Two papers were written; the one by Shirakura is published already.

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(Note: In some papers, the (present) name A. Wijetunga appears as the (old) name W. Ariyaratna.)

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Reducing costs of experiments; optimal designs; sensitive designs; statistical phenomena in psychology experiments.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The investigators obtained optimal balanced designs of the mixed factorial type which allow estimation of all main effects. Major advances were made in the theory of D-optimal symmetrical factorial designs whose points consitute a set of parallel hyperplanes in a finite Euclidean space. A very good theory of designs which are very sensitive in the sense that they allow elimination of heterogeneity in several directions within each block was developed. Studies were made in the structure of statistically significant effects in psychological experiments and an important phenomenon was observed. These researches (CONT.)

ITEM #20, CONTINUED: open up new avenues of statistical research, whose practical importance cannot be exaggerated since it directly results in the reduction of experimental costs for any given level of accuracy or in the maximization of accuracy for any given level of expenditure decided upon.